

# HOW PAPER IS MADE

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## History of Papermaking

**2000 years ago:** The first paper was produced in 105 A.D. for the Chinese Royal Court. It was made from discarded rags, fishing nets, hemp and China grass. For many centuries paper was made from plant materials, recycled rags and waste paper.

**1400's - 1700's:** Handmade papermaking spread world wide and included new materials such as animal skins. Papermaking came to the United States and the first paper mill was built in Philadelphia in 1690. The main resource used at that time was recycled rags. Demand for paper was still relatively low, so paper production continued to be done by hand.

**1800's:** In the early 1800's a machine for papermaking was developed, allowing continuous rolls of paper to be made. Many of the new machines used straw, and by 1871 America produced over 100 tons of straw paper a day.

**1920's to the present:** In the 1920's wood replaced straw as the primary raw material. A rise in both population and literacy rates increased the demand for paper. The abundance of forests during the 19th century in America made wood fibers the material of choice for paper-making. Manufacturing paper using machines and wood fibers prevails today.

## *Resources used in this brochure:*

**An Analysis of the Timber Situation in the U.S. 1989-2040** (General Technical Report RM-199). – Richard W. Haynes  
U.S. Department of Agriculture – 1990  
Fort Collins, Colorado

### **How Paper is Made**

Leslie Perrins  
Threshold Books Limited – 1985  
New York, New York

### **Paper By Kids**

By Arnold Grummer  
Tilling Press, Inc. – 1980  
Minneapolis, Minnesota

### **Recycled Papers– The Essential Guide**

Claudia G. Thompson  
The MIT Press – 1992  
Cambridge, Massachusetts

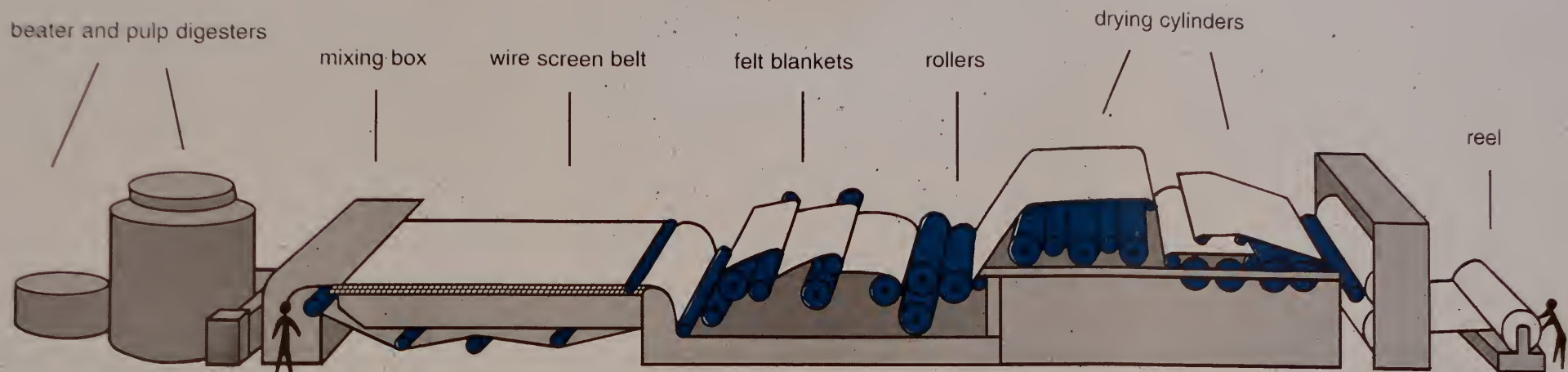
### **The Story of Paper**

Roy P. Whitney  
TAPPI Press – 1984  
Atlanta, Georgia

For more copies of this brochure  
call (415) 554-3400 or write to:

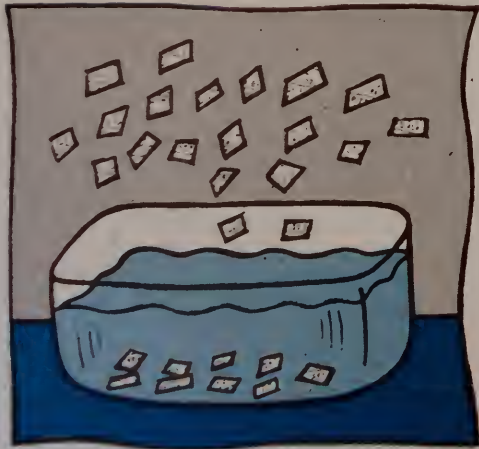
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This diagram is an example of a paper machine used in a mill. The recipe given below is for handmade papermaking, but it is similar to the way mills actually make paper. Be creative and have fun!

## Procedure



### 1. Tearing

Tear paper into little pieces. Soak these in warm water for at least 30 minutes. You may let soak overnight.

## Making Recycled Paper Recipe

Activity time: 1 hour

Preparation time: 20 minutes

Group size: Divide your class into groups of 4 or 5 students

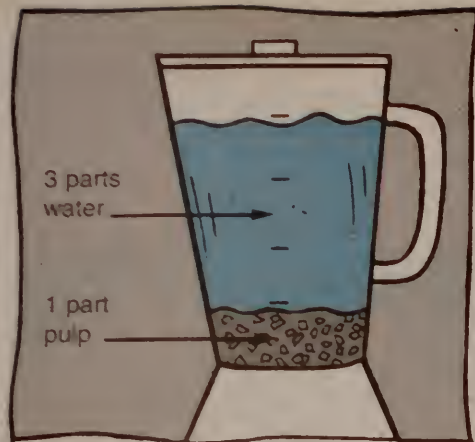
Grades: 2nd-12th

Subjects: Social studies, science and art

### Materials Needed:

- **Paper:** one sheet per person of white or colored paper, paper bags, newspaper, etc.
- **Screen on a frame** (*corresponds to the wire screen belt*)  
To make one, buy window screen material (plastic or fiberglass will prevent cuts) and canvas wood stretcher bars at an art store. Staple the screen to the frame.
- **Plastic container for soaking the paper** (*corresponds to the mixing box*)
- **Blender or hand mixer** (*corresponds to the beater*)
- **Extra newspaper** (*corresponds to the felt blankets*)





## 2. Pulping

Place 3 parts of water to 1 part paper into a blender. Blend for approximately 30 seconds. This will break up the paper into pulp.



## 4. Drying

Turn the screen and newspaper over and set it on the table. Slowly lift the screen up. Let the paper pulp on the newspaper dry for at least 24 hours. Once it dries the recycled paper will easily peel off the newspaper.



## 3. Pouring and Pressing

Over a sink or a container, pour the pulp from the blender onto the screen evenly. Place a layer of newspaper over the pulp and GENTLY press out excess water.



## 5. Decorating

Put dried flowers, glitter, or confetti onto paper when wet or glue on when paper is dry.

## Fun Extensions and Ideas

### Before:

- Try different types of paper i.e., magazines.
- Add texture and sparkle. Put glitter, flowers, dryer lint or tea bags with paper into blender.
- Color your paper. Use food coloring in the blender. Add colored spices to the blender such as turmeric or paprika and give paper a natural color.
- Examine a spoonful of pulp with a microscope or hand lens.

### After:

- Turn your pulp into seed planters by shaping it in muffin trays.
- Turn your pulp into jewelry beads, let them dry, color them and string them to make a necklace.
- To create a finish on your paper, mix cornstarch with water and paint it onto the dried paper.
- Use cookie cutters to make shapes out of your paper.

## Process

Paper is made from cellulose, which is found in most plants. Wood is not the ideal material for paper because it only has a 50% cellulose content (much less than cotton, for example). Virtually all paper made in the United States comes directly from cut trees or from "residue" at lumber mills. On the West Coast the species of trees used for paper products include Douglas Fir, Ponderosa Pine and Sitka Spruce.

Trees harvested for papermaking get chipped into small pieces. The wood chips are boiled in a mixture of chemicals and water in a huge machine called a "digester". The digester works like a pressure cooker, in which the wood and chemicals are cooked together under intense heat to form a pulp. The pulp is then strained, and pressed using rollers. The damp paper passes through heated cylinders and is dried in sheets. Finally the paper is rolled onto a jumbo reel, ready to be shipped.

• Please note: there is a diagram which illustrates the process of papermaking inside. ↓

## Impact

There are many environmental concerns associated with the current method of papermaking. Here are a few.

**1. Deforestation:** Less than 5% of the virgin (never cut) forest that once covered the U.S. remain. The clear cutting method used in "harvesting" many forests reduces biodiversity and damages ecosystems.

Wood used for paper accounts for 42% of all timber harvested. This indicates that manufacturing paper from raw materials contributes to deforestation.

**2. Pollution:** Another serious impact on the environment from papermaking is the chemical process associated with the pulping and bleaching of paper. The U.S. Environmental Protection Agency reports that the paper industry is the third most polluting industry in the country. In 1990, the paper industry released almost 300 million pounds of toxic materials into our water ways and atmosphere.

**3. Waste:** Even after paper is made and used, it creates still another problem—Garbage! Paper is the single largest component of landfills. From coast to coast, paper makes up about 40% of our nation's waste.

## Alternatives

Given the problems created by paper manufacturing and waste, alternatives are clearly needed. One alternative is to use recycled paper. By using one ton of recycled paper (instead of paper made from wood fibers) we can have the following environmental impact:

- Conserve 4,100 kilowatt hours of energy (enough to power an average home for six months)
- Save 7,000 gallons of water
- Keep 60 pounds of air pollution out of the atmosphere
- Save 3 cubic yards of landfill space
- Save 17 trees
- Create more jobs

Here are some specific ways you can help make a difference.

- Purchase recycled paper.
- Recycle as many types of paper as possible (check with your local recycling service).
- Reuse paper as much as possible.
- Reduce the amount of paper you use/waste.
- Learn how to make your own paper. Use the recipe inside. ↓

